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UNRAVELLING THE THREADS OF HOSPITAL ACQUIRED INFECTIONS: A COMPREHENSIVE STUDY OF EPIDEMIOLOGY, PREVALANCE AND RISK FACTORS.

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ABSTRACT:

Objective: Healthcare-acquired infections (HAIs) are localized or systemic conditions caused by infectious agents or toxins, often appearing over 48 hours after hospitalization, affecting specialized treatment, hemodialysis, chemotherapy, institutionalized individuals, and nosocomial microorganisms.

Methods: The study was a prospective observational study conducted at a tertiary care hospital. Data was analyzed using a form which was analyzed further and results are reported.

Results: The study involved 97 participants with comorbidities like diabetes, hypertension, and pulmonary disease. Risk factors for developing HAI included central line presence, urinary catheter presence, mechanical ventilation, antimicrobial exposure, and chronic conditions. Commonly acquired HAIs included CLABSI, CAUTI, SSI, and VAP, with 44 subjects with CAUTI, 22 with VAP, 18 with CLABSI, and 12 with SSI.

Conclusion: Hospital acquired infections (HAIs) are a global concern due to antibiotic-resistant bacteria, particularly in developing countries. Most hospital-acquired infections (HAIs) are spread through surface contact, catheters, intravenous lines, or surgical incisions. Conventional antibiotics are ineffective, leaving only last-resort antibiotics as treatment options. Healthcare professionals are concerned, prompting governmental, academic, and medical organizations to implement multiple-intervention infection control strategies to reduce mortality, morbidity, and medical costs.

Keywords: Hospital acquired infections, HAI, CLABSI, CAUTI, SSI, and VAP.

INTRODUCTION:

Healthcare-acquired infections (HAIs) are localized or systemic conditions caused by infectious agents or their toxins, occurring during hospitalization and typically appearing more than 48 hours later. HAIs include those receiving specialized treatment, on hemodialysis or chemotherapy, hospitalized for two or more days in the past three months, and institutionalized individuals. HAIs exhibit distinct characteristics compared to other infections, including a distinct microbiological pattern, with some microorganisms being considered nosocomial, unlike community-acquired infections.[1]

Hospital-acquired infections (HAIs) significantly increase morbidity, mortality, and medical costs. In the USA, they cause about 1.7 million infections and 99,000 deaths annually. HAIs spread through various routes, including surfaces, air, water, intravenous, oral, and surgery. Interventions like proper hand and surface cleaning, better nutrition, sufficient nurses, ventilator management, coated urinary and central venous catheters, and HEPA filters have been associated with lower infection rates. Bundling multiple infection control techniques and strategies may offer the best opportunity to reduce HAI morbidity and mortality. These strategies not only save medical costs associated with infections but also reduce the need for long or multiple-drug antibiotic courses. Lower antibiotic drug usage reduces the risk of antibiotic-resistant organisms and improves antibiotic efficacy.[2,3]

Healthcare-associated infections (HAIs), including CLABSI, CAUTI, SSI, and VAP, significantly impact patient safety, hospital stays, and healthcare costs. Understanding epidemiology, risk factors, and preventive measures is crucial.[4]

Definitions:

- Central Line-Associated Bloodstream Infections (CLABSI) are significant healthcare-related infections caused by central venous catheters, requiring strict aseptic techniques and insertion practices to prevent morbidity and mortality.[5]
- Catheter-Associated Urinary Tract Infections (CAUTI) are prevalent HAIs, especially in patients with indwelling catheters, emphasizing the need for timely catheter removal and infection prevention protocols.[6]
- Surgical Site Infections (SSI) are infections near surgical incision sites, causing severe complications like organ damage and hospitalization. Preoperative screening, antibiotic prophylaxis, and strict aseptic techniques prevent SSIs.[7]
- VAP is a respiratory infection in mechanical ventilation patients, significantly contributes to HAIs in intensive care units. Preventive measures like bed head elevation and sedation interruption reduce VAP incidence.[8]

Healthcare-associated infections (HAIs) like CLABSI, CAUTI, SSI, and VAP are common due to invasive procedures, compromised immune status, and prolonged hospitalization.

Mitigating these risks requires a multidisciplinary approach, including strict infection control, antimicrobial stewardship, and ongoing surveillance. Addressing these challenges is crucial for better patient outcomes and reducing HAI burden.[9]

MATERIALS AND METHODS:

This study was a prospective observational study carried out at a tertiary care hospital. Patient forms, medical records, case sheets, and laboratory examinations were used to compile data. To analyze the data, a form was employed. Patients were enrolled after giving their informed consent. For further analysis, the data was entered into an MS Excel 2016 spreadsheet and imported into IBM SPSS Software Version 22.

RESULTS:

The study was carried out on 97 subjects. Based on the age of subjects, there were 8 subjects of age <15 years, 52 subjects of age 41-60 years, 12 subjects of age 41-60 years and 25 subjects of age >60 years. There was male prevalence observed with 61 male subjects and 36 female subjects.

The BMI was calculated and divided into three groups. There were 15 patients with BMI of <20 kg/m2, 9 subjects with BMI of 20-25 kg/m2 and 73 subjects with BMI of >25 kg/m2. Based on the comorbidity, diabetes was found in 19 subjects, hypertension in 28 subjects, chronic obstructive pulmonary disease in 25 subjects, congestive heart failure in 11 subjects and coagulopathy in 14 subjects. Subjects reported to have HAI were 49 subjects from medical intensive care unit, 25 subjects from surgical unit and 23 subjects from general medicine unit.

Table-1 Demographics

	No of patients	Percentage
Age (in years)		
<15	8	8.24%
16-40	52	53.60%
41-60	12	12.37%
>60	25	25.77%
Gender		
Male	61	62.88%
Female	36	37.11%
BMI (kg/m2)		
<20	15	15.46%
20-25	9	9.27%
>25	73	75.25%
Comorbidity		
DM	19	19.58%
HTN	28	28.86%

COPD	25	25.77%
CHF	11	11.34%
Coagulopathy	14	14.43%
Department		
Medical Intensive Care Unit	49	50.51%
Surgical Unit	25	25.77%
General Medicine Unit	23	23.71%

The risk factors for developing the HAI was observed and recorded. 9 subjects had presence of central line during their hospitalization, 41 subjects had presence of urinary catheter, 28 subjects were on mechanical ventilation, 32 subjects had previous exposure to antimicrobials, and 17 subjects were prescribed regular steroids for their chronic conditions.

The surgical history of patients was also recorded that revealed 72 subjects had elective surgeries and 25 subjects had non-elective surgeries. The length of hospital stay varied among the enrolled subjects that was 12 subjects were hospitalized for <5 days, 18 subjects were hospitalized for 6-10 days, 21 subjects were hospitalized for 11-20 days and 46 subjects were hospitalized for >20 days.

Table-2 Risk factors for HAI

	No of patients	Percentage
Presence of central line	9	9.27%
Presence of urinary catheter	41	42.26%
Use of Mechanical Ventilation	28	28.86%
Previous exposure to antimicrobials	32	32.98%
Chronic steroid use	17	17.52%
Surgical History		
Elective	72	74.22%
Non-Elective	25	25.77%
Length of hospital stay (in days)		
<5	12	12.37%
6-10	18	18.55%
11-20	21	21.64%
>20	46	47.42%

Based on the samples collected to perform cultures, and confirm the HAI the specimens were collected from pus, blood, urine, respiratory swab or endotracheal secretions. 28 subjects had pus cultures, 19 subjects had blood cultures, 24 subjects had urine cultures and 25 subjects had respiratory swab or endotracheal cultures

Table-3 Samples

	No of patients	Percentage
Pus	28	28.86%
Blood	19	19.58%
Urine	24	24.74%
Respiratory swab or endotracheal secretions	25	25.77%

The commonly acquired HAI included Central line associated blood stream infection [CLABSI], Catheter associated Urinary Tract Infections [CAUTI], Surgical Site Infections [SSI] and Ventilator Associated Pneumonia [VAP]. There were 44 subjects with CAUTI, 22 subjects with VAP, 18 subjects with CLABSI and 12 subjects with SSI.

Table-4: Types of HAI

	No of patients	Percentage
Central line associated blood stream infection (CLABSI)	18	18.55%
Catheter associated Urinary Tract Infections (CAUTI)	44	45.36%
Surgical Site Infections (SSI)	12	12.37%
Ventilator Associated Pneumonia (VAP)	22	22.68%

DISCUSSIONS:

Antibiotic-resistant bacteria have increased the burden of Hospital Acquired Infections (HAIs) globally, particularly in developing countries. Their emergence and evolution have made conventional antibiotics ineffective, leaving only a limited set of last-resort antibiotics as the main treatment option for multidrug resistant HAIs. In 2017, the WHO listed twelve antibiotic-resistant priority pathogens, including high-risk pathogens like A. baumannii, carbapenem-resistant Pseudomonas aeruginosa, and Enterobacteriaceae. These pathogens exhibit multidrug resistance and high virulence, particularly the notorious 'ESKAPE' pathogens, which have been implicated in HAIs in both developed and developing countries.[10,11,12,13]

Current research on nosocomial infections have focused heavily on the need for novel antibiotics, improved antibiotic management, and more accurate diagnostic methods to identify infections early. Morbidity and mortality from hospital-acquired infections (HAIs) can be significantly decreased with better drug management and earlier infection diagnosis. However, numerous no pharmacological measures can considerably lower the incidence of HAIs, although these are frequently disregarded in actual practice.[2,14]

Most hospital-acquired infections (HAIs) are spread through surface contact, catheters, intravenous lines, or surgical incisions. However, many airborne pathogenic bacteria are viable but not culturable. Some experts estimate that as little as 1% of viable bacteria are culturable by standard microbiological techniques. For example, Serratia marcescens, Klebsiella planticola, and

Cytophaga allerginae in 4-hour-old bioaerosols were 48, 73, and 66% of their original counts, despite none being culturable on tryptic soy agar plates.[15] Many pathogens present on sneezes evaporate quickly into small droplet nuclei, which can remain suspended for hours and travel long distances before settling. Non-pharmacological interventions, such as proper hand washing, better nutrition, separate patient rooms, sufficient nursing staff, coated urinary and CVCs, HEPA air filters, copperesilver water ionisation, and various interventions for ventilated and surgical patients, have been shown to significantly reduce the risk of nosocomial morbidity and mortality. These infection control interventions have been shown to pay for themselves in terms of reduced total medical costs.[16]

Healthcare professionals are particularly worried regarding healthcare-related infections (HAIs), which has prompted governmental, academic, and medical organizations to take a number of actions. A significant global organization is the National Nosocomial Infection Surveillance System (NNISS). Observational studies have been carried out in critical care units for more than 20 years, such as the ENVIN group. The EPINE working group gathers information on patients admitted at a certain time point and annually examines the frequency of HAI in various hospital units. These initiatives try to stop the growth of HAIs.[1]

Multiple-intervention infection control strategies can significantly reduce mortality, morbidity, and medical costs in hospitals. Increased support from patient advocacy groups, nursing, medical, public health associations, hospital administrators, health insurance companies, businesses, labor groups, media, and public officials is needed for improved hospital infection control. Research and implementation of these strategies should be a priority in healthcare in the early 21st century.

CONCLUSIONS:

Hospitals need multiple interventions for optimal infection control, but few use the broad range of available methods. Bundling multiple interventions can yield better results than single ones. Larger interventional studies should employ large numbers of methods simultaneously, resulting in larger declines in hospital acquired infection rates. However, determining the efficacy of individual interventions when multiple interventions are used is challenging. Antibiotics' heavy use in medicine and limited development of new ones are expected to increase multidrug-resistant bacteria levels. Implementing multifactorial non-pharmacological infection control strategies can reduce nosocomial infections and improve antibiotic efficacy.

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